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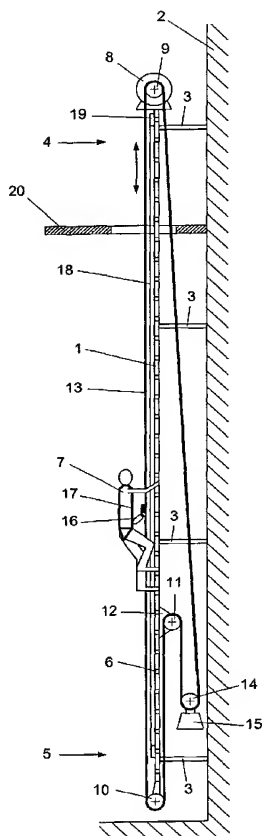
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(54) Title: LADDER CLIMBING ASSISTANCE DEVICE



(57) Abstract: A ladder climbing assistance device for use with an essentially vertical ladder (1). The ladder climbing assistance device comprises a line (13) extending along the ladder (1); a motor (8) arranged to provide an essentially constant traction in the line (13); and means adapted for connecting a person (7) climbing the ladder (1) to the line (13). The line (13) forms a closed loop between a first wheel (9) provided at an upper end (4) of the ladder (1) and a second wheel (10) provided at a lower end (5) of the ladder (1).



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### Ladder climbing assistance device

The invention relates to a ladder climbing assistance device for use with an essentially vertical ladder, said ladder climbing assistance device comprising:

- 5       – a line extending along the ladder;  
      – a motor arranged to provide an essentially constant traction in the line;  
      and  
      – means adapted for connecting a person climbing the ladder to the line.
- 10   Such ladder climbing assistance devices are especially useful in connection with ladders provided in windmills, masts, towers, silos, deep wells, etc. and are of great benefit, wherever maintenance and installation personnel have to carry tools or other ballast with them during their ascent or descent.
- 15   A known ladder climbing assistance device consists of a line that is connected to a motor driven winch positioned at the lower end of the ladder and extends over a wheel provided at the upper end of the ladder. At the distal end of the line a slide is provided, said slide being displaceably connected to a rail that extends in the full length of the ladder. The slide is
- 20   provided with means that allows a person climbing the ladder to connect himself to the slide by means of a short wire connected to a harness worn by the person. In use, the person connects himself to the slide and starts the motor by pulling a string arranged adjacent the ladder. The motor is controlled to provide a constant traction to the line of e.g. 500 N
- 25   (corresponding to about 50 kg) and the person therefore experiences that his weight is correspondingly reduced. In this way ascending and descending the ladder is substantially facilitated since a person with a body weight of e.g. 80 kg only has to carry 30 kg.
- 30   Another ladder climbing assistance device is known from JP-A-08199956 that discloses a self-propelled slide that is in driving engagement with a rail extending in the full length of the ladder. The slide is provided with a motor and the driving engagement with the rail entails that the slide can be driven displaceably along the rail in either direction. The climbing force of the slide
- 35   is adjusted in such manner that the slide lifts most of the weight of a person

ascending or descending the ladder, thereby facilitating the ascent or descent.

5 A major disadvantage of these known ladder climbing assistance devices is that the slide – it being self-propelled or suspended by a line – must be positioned at specific location when a person is to ascend or descend the ladder. If a person is at the lower end of the ladder the slide must be displaced to this lower end, if it is not there, and if the person is at the upper end of the ladder the slide must be displaced to this upper end. If only one  
10 person is to ascend and later on to descend the ladder, the slide will normally be in the right location since it is located where the person left it after ascending or descending. However, if two or more persons are to ascend or descend the ladder, which is not unusual, the slide must be displaced from the upper end of the ladder to the lower end of the ladder or  
15 vice versa before the next person can ascend or descend.

It is therefore an object of the invention to provide a ladder climbing assistance device that allows more persons to use the climbing assistance device when ascending or descending and that does not have the above-  
20 mentioned disadvantage.

This is achieved by arranging the ladder climbing assistance device mentioned in the opening paragraph in such manner that the line forms a closed loop between a first wheel provided at an upper end of the ladder and  
25 a second wheel provided at a lower end of the ladder.

Thereby it is obtained that a part of the line always extends along the ladder which means that the person or persons ascending or descending can connect themselves to the line at any time and at any location on the line.  
30 For instance, a first person to ascend the ladder connects himself to the line at the lower end of the ladder and he starts climbing. When he has reached the top - or any other position between the lower end and the upper end of the ladder where e.g. maintenance work is to take place - he disconnects himself from the line, and a second person may then immediately connect  
35 himself to the line and start ascending. This is not possible by the prior art

climbing assistance devices where the slide has to be returned to the lower end of the ladder before the second person can start ascending. The line forming a closed loop may also be called an endless line.

- 5 It should be emphasized that the term "line" when used in this specification is intended to include any form of a flexible, elongate element capable of fulfilling the described function, i.e. including steel wires, ropes, straps, chains and other flexible, elongate elements.
- 10 In a preferred embodiment of the ladder climbing assistance device according to the invention the motor is connected to the first wheel provided at the upper end of the ladder, and this first wheel is in frictional engagement with the line. Thereby, traction is applied to the line directly above the ladder which means that the part of line that is loaded is as short as possible.
- 15 In a preferred embodiment a line tightening arrangement is provided in order to keep the line stretched at all times. The line tightening arrangement furthermore ensures that the line is kept engaged with the wheels provided at each end of the ladder.
- 20 A simple form of a line tightening arrangement comprises a third wheel and a freely suspended weight-loaded wheel tightening the line loop.
- 25 The motor, the first wheel, the second wheel and the third wheel must be supported by any structure that is fixed in relation to the ladder. In a preferred embodiment, the motor, the first wheel, the second wheel and the third wheel are supported by the ladder, whereby the ladder climbing assistance device can be easily mounted onto existing ladders if desired.
- 30 Advantageously, the line has a generally smooth surface which ensures that it can easily be supported by the wheels.

If the line has a generally smooth surface the means adapted for connecting a person climbing the ladder with the line comprises a clamping device

connected to a harness worn by the person. Such clamping device and harness can be of any known kind.

5 The invention will be described in detail in the following with reference to the drawings in which

Fig. 1 shows a schematic sideview of a ladder climbing assistance device according to the invention, and

10 Fig. 2 shows a part of a line and a clamping device in a first embodiment for use in the ladder climbing assistance device according to the invention.

Fig. 1 shows a schematic sideview of a ladder climbing assistance device according to the invention used in connection with a ladder 1 that is secured  
15 to a wall 2 by brackets 3 distributed along the length of the ladder 1. The ladder 1 has an upper end 4 and a lower end 5 and is provided with steps 6, and a person 7 is ascending or climbing the ladder 1. The ladder 1 can be positioned in windmills, masts, towers, silos, deep wells, etc.; the present invention is, however, independent of the use.

20 In the embodiment shown in Fig. 1 a motor 8 is provided at the upper end 4 of the ladder 1. The motor 8 is mounted on the end of the ladder 1 and is provided with a first wheel 9. A second wheel 10 is provided at the lower end 5 of the ladder 1, and this second wheel 10 is also mounted on the ladder 1.  
25 A third wheel 11 also supported by the ladder 1 via a bracket 12 is provided between the first and second wheels 9,10 and between the ladder 1 and the wall 2. Of course, the motor 8 and the first, second and third wheels 9,10,11 need not be supported by the ladder 1 as such, but may be supported by any other structure that is fixed in relation to the ladder 1.

30 A line 13 forming a closed loop is wound around the first wheel 9, the second wheel 10 and the third wheel 11 as shown. A line tightening arrangement comprising a weight-loaded wheel 14 carrying a weight 15 is provided freely suspended as shown. The line tightening arrangement keeps the line  
35 stretched at all times.

The line 13 is in frictional engagement with the first wheel 9 that is drivingly connected to the motor 8. This means that when the motor 8 is activated it rotates the first wheel 9 clockwise if the person 7 is ascending while it rotates the first wheel 9 anti-clockwise if the person 7 is descending. The amount of rotation is controlled in such manner that the person 7 experiences a constant upwardly directed force of a predetermined magnitude, e.g. 400 N, corresponding to a lift of about 40 kg. This means that if the person 7 has a total weight of e.g. 90 kg, he experiences that his total weight is reduced by 40 kg and he only has to carry the remaining 50 kg. Thereby his ascent as well as his descent is facilitated considerably. Controlling the motor 8 in this manner is a generally known technique used in the prior art ladder climbing assistance devices and will not be described further in this specification.

In use, the person 7 approaches the ladder 1 and connects himself to the line 13 by means of any suitable connecting means of which an example is described below with reference to Fig. 2. The connecting means comprises a chain link 16 that is connected to a harness 17 worn by the person 7. When the person has connected himself to the line 13, the motor 8 is activated by the person pulling a switch rope 18 arranged in proximity of the ladder 1. The switch rope 18 is supported by the ladder 1 and is connected to an on/off switch 19 that activates/deactivates the motor 8 when the switch rope 18 is pulled downwards. This causes the motor 8 to apply a constant traction in the line 13 of e.g. 400 N as described above.

When the user starts to ascend the ladder 1 he experiences that his body weight has been reduced by about 40 kg and he can ascend the ladder 1 with great ease without getting too exhausted. Likewise, he can descend the ladder 1 with corresponding ease.

When the person 7 has reached his destination such as a platform 20 he disconnects himself from the line 1 and can start to perform the work to be done at the platform level. If another person (not shown) is to accompany the first person 7 at the platform 20, this second person can immediately connect himself to the line 13 and ascend the ladder 1, utilising the ladder climbing

assistance device in a manner similar to that described above. Thus, the main advantage of the ladder climbing assistance device according to the invention over the prior art devices is that more than one person can utilise the ladder climbing assistance device immediately after each other without  
5 having to return a slide or the like. In special circumstances the ladder climbing assistance device according to the invention may even be designed to support two or more persons at the same time, such that these persons are allowed to ascend or descend the ladder simultaneously.

10 Fig. 2 shows a part of the line 13 used in the ladder climbing assistance device shown in Fig. 1 and a preferred embodiment of a clamping device 21 used for connecting a person 7 with the line 13. The line 13 can have any suitable form and be made of any suitable material. In a preferred embodiment the line 13 is a standard rope of the type used in mountain  
15 climbing.

The clamping device 21 may also be a standard device used in mountain climbing comprising a bent metal plate forming a line guide 22 and provided with a spring-biased pawl 23 and an attachment opening 24. A connector  
20 element such as an openable chain link 16 is attached to the attachment opening 24 and is intended for being connected to a harness 17 worn by the person 7 (see Fig. 1).

In use the person 17 connects the chain link 16 to his harness 17, thereby  
25 ensuring safe connection of the clamping device 21 with the harness 17. Then the spring-biased pawl 23 is forced clockwise against the spring force by a finger to the position shown with dotted lines and the line 13 is captured by the line guide 22. Then the spring-biased pawl 21 is released and a spring causes it to turn anti-clockwise until it engages the line 13. Any force now  
30 applied to the line in an upward direction causes the spring-biased pawl 23 to engage the line 13 even stronger, thereby ensuring a safe engagement between the line 13 and the clamping device.

When the motor 8 of the ladder climbing assistance device is activated by  
35 pulling the switch rope 18, the line 13 is displaced upwards until a constant



traction of e.g. 400 N is achieved. At that moment the person 7 experiences a lift via the clamping device 21, the chain link 16 and the harness 17 he is wearing corresponding to 40 kg. This means that when he starts ascending or descending he experiences that his total weight has been reduced by 40 kg and due to the force control of the motor 8, he will constantly experience this weight reduction irrespectively of his ascending or descending speed. Even if he takes a break he will experience the weight reduction unless he stops the motor 8 by pulling the switch rope 18.

10 The invention has been described with reference to a preferred embodiment of the ladder climbing assistance device. Many of the elements comprised in the device may, however, be shaped differently or be replaced by other elements performing the same function. For instance, the line forming the closed loop may be made of any suitable material such as nylon, cotton or  
15 even steel or any combination of such materials, e.g. for reinforcement reasons. The line need not be totally smooth over its entire length as there might be provided beads extending outwards from the line for improved engagement with the clamping device. Also, through-going openings may be provided in the line in which connecting means can be attached.

20 The first wheel 9 connected to the motor 8 can be in frictional engagement with the line by any suitable means. In a preferred embodiment the wheel 9 comprises two opposed conical discs forming a V-shaped groove at the rim of the wheel 9. Through-going bores are provided close to the rim, and the  
25 inwardly facing edges of these bores provides an excellent frictional engagement with the line. This kind of wheel 9 is only useful if the line is a relatively soft rope that allows the outer surface thereof to be slightly deformed into the through-going bores. If another line type is used, the wheel must be adapted thereto.

30 Finally, a fall protection system must normally supplement the ladder climbing assistance device; such fall protection system is, however, well-known in the art and is not a part of the present invention.

## Claims

1. A ladder climbing assistance device for use with an essentially vertical ladder (1), said ladder climbing assistance device comprising:
- 5       – a line (13) extending along the ladder (1);
- a motor (8) arranged to provide an essentially constant traction in the line (13); and
- means adapted for connecting a person (7) climbing the ladder (1) to the line (13),
- 10   **characterised in** that the line (13) forms a closed loop between a first wheel (9) provided at an upper end (4) of the ladder (1) and a second wheel (10) provided at a lower end (5) of the ladder (1).
2. A ladder climbing assistance device according to claim 1, **characterised in** that the motor (8) is connected to the first wheel (9) provided at the upper end (4) of the ladder (1); and that the first wheel (9) is in frictional engagement with the line (13).
- 15
3. A ladder climbing assistance device according to claim 1 or 2,
- 20   **characterised in** that a line tightening arrangement is provided.
4. A ladder climbing assistance device according to claim 4, **characterised in** that the line tightening arrangement comprises a third wheel (11) and a freely suspended weight-loaded wheel (14) tightening the line loop.
- 25
5. A ladder climbing assistance device according to claim 4, **characterised in** that the motor (8), the first wheel (9), the second wheel (10) and the third wheel (11) are supported by any structure that is fixed in relation to the ladder (1).
- 30
6. A ladder climbing assistance device according to claim 4, **characterised in** that the motor (8), the first wheel (9), the second wheel (10) and the third wheel (11) are supported by the ladder (1).

7. A ladder climbing assistance device according to any one of claims 1-6, **characterised in** that the line (13) has a generally smooth surface.

5 8. A ladder climbing assistance device according to claim 7, **characterised in** that the means adapted for connecting a person (7) climbing the ladder (1) with the line (13) comprises a clamping device (21) connected to a harness (17) worn by the person (7).

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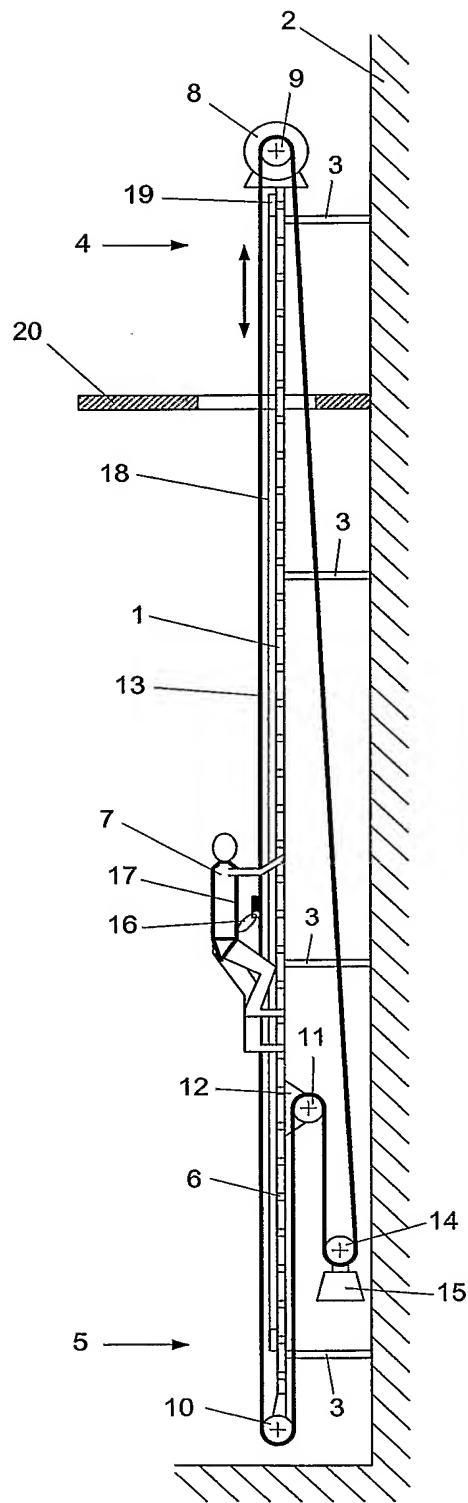


Fig. 1

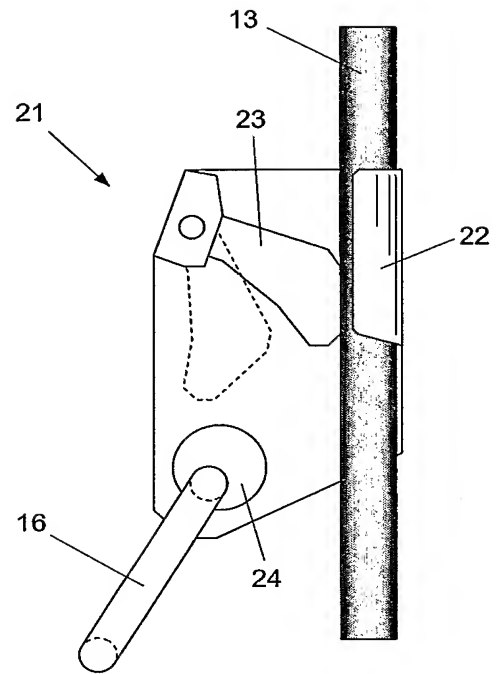


Fig. 2

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/DK 03/00114

## A. CLASSIFICATION OF SUBJECT MATTER

IPC7: E06C 7/12, E06C 7/18 // E06C 9/02

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: E06C, B66B, B66C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 2440906 A1 (MOSER ROBERT), 6 June 1980 (06.06.80)	1-2,8
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Y	FR 2041920 A1 (CLOQUIE HERVE), 5 February 1971 (05.02.71), page 1, line 30 - line 34, figures 1-2	3-7
Y	DD 261525 A1 (WTZ FÜR ARBEITSSCHUTZ BEIM MINISTERIUM FÜR BAUWESEN), 2 November 1988 (02.11.88), figure 1, abstract	3
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☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

\* Special categories of cited documents:

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## INTERNATIONAL SEARCH REPORT

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## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

29/04/03

International application No.  
PCT/DK 03/00114

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